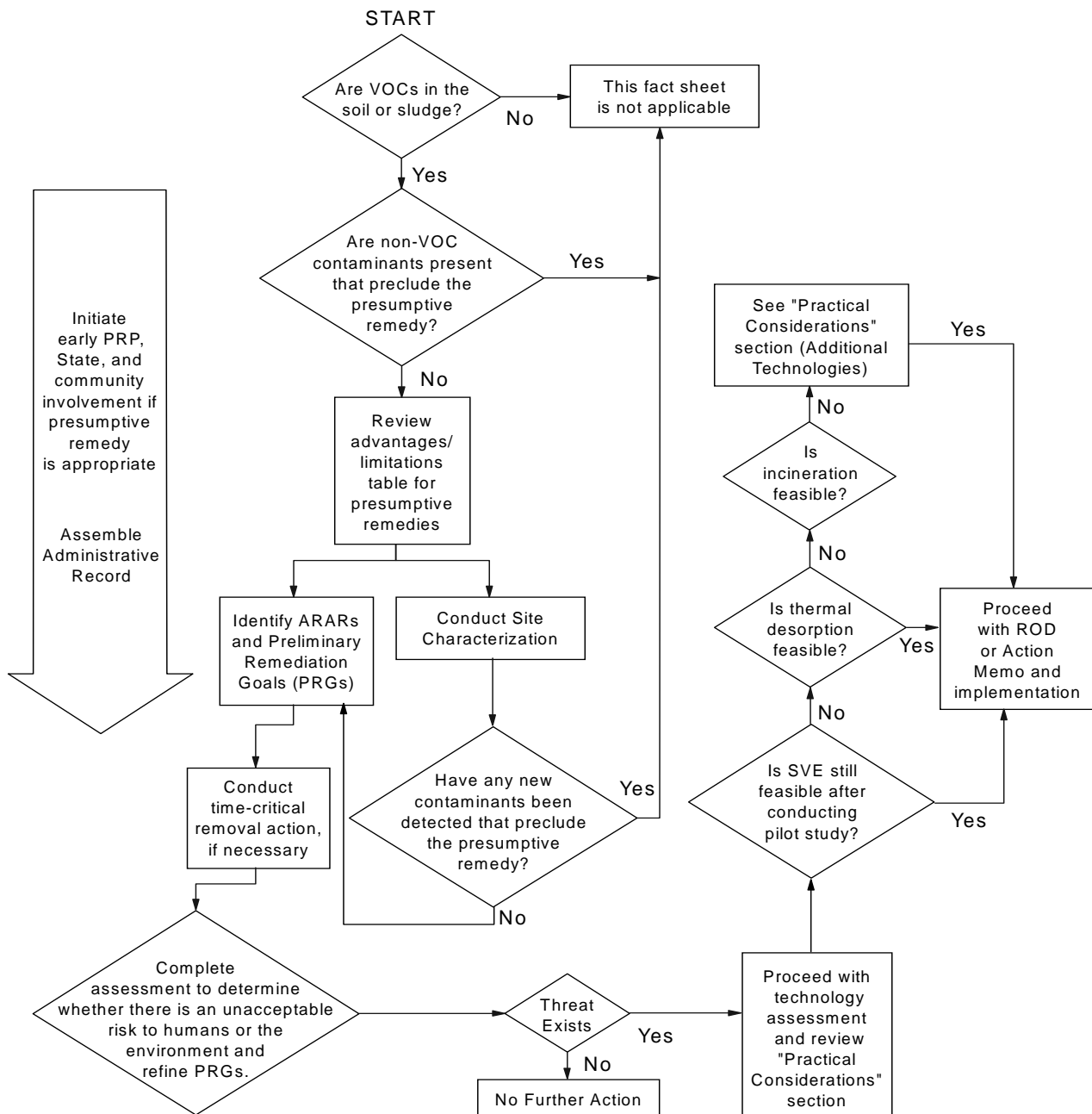


Results from routine quarterly sampling

Contaminants Present	Sampling Well #1	Sampling Well #2	Sampling Well #3	Sampling Well #4	Cleanup Level
TCE (ppb)	not sampled	600	not sampled	4	5
Tc-99 (pCi/L)	not sampled	not sampled	not sampled	not sampled	300

Note: Tank presence was unknown until 3 months ago when presence of TCE in sampling well #2 and a resulting review of historical site records triggered a search for a source. Records show Tc-99 sludges may have been in the tank.

Decision tree for investigating and selecting a remedy at solvent sites



Modified from: *Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites with Volatile Organic Compounds in Soils* (Quick Reference Fact Sheet), EPA 540-F-93-048, September 1993

Key core team interactions to implement principles

Principle	Scoping/Strategic Planning	Data Collection/ Analysis	Design/ Implementation
Problem identification	Construct problem statement	Determine if condition exists. Select remedy	Determine if uncertainty threshold has been exceeded. Approve contingencies
Early identification of response actions	Identify remedial objectives	Select early actions or limited technology options	Structure procurement strategy and approve design
Management of uncertainty	Identify minimum basis for determining if a problem exists	Evaluate tradeoffs between <i>reducing</i> and <i>counteracting</i> uncertainty	Authorize use of contingencies when necessary

Response actions and decision rules

Problem Statement: Total lead in a 60m x 20m x 1m deep volume of soil exceeds the action level of 1,000 ppm, as measured in an average of 5 random samples using X-ray fluorescence. [Note: the core team has determined that land use is industrial]

Hierarchy of Probable Technologies	Potential Fatal Flaws or Implementation Issues
1. Excavate, solidify/stabilize, dispose	<ul style="list-style-type: none">• Presence of sensitive, uninterruptible utilities that prevent excavation• Treatability study unable to produce product that meets leaching criteria
2. In-situ solidification/stabilization	<ul style="list-style-type: none">• Underground obstructions or geology preclude application of technology
3. Cap in place	<ul style="list-style-type: none">• Future use scenario involves intrusive activity or precludes long-term maintenance of cap

Example Decision Rule (after agreement by core team): **IF** the total lead concentration in a 60m x 20m x 1m deep volume of soil exceeds 1,000 ppm, as measured in an average of 5 random samples using X-ray fluorescence, *and* off-site landfill waste acceptance criteria are met, *and* sensitive, uninterruptible utilities are not present, **THEN** excavate, solidify/stabilize, and dispose in an off-site landfill, **ELSE** if underground obstructions and geology are acceptable, **THEN** implement in-situ solidification/stabilization.

Potential Innovative Alternatives: (A) thermal stripping of lead and recovery (in-situ or ex-situ); or (B) chemical recovery of lead

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- The likely response action is the solution to the problem statement part of the decision rule, i.e., the action to take if the criteria defining the problem are met. Actions must be tied to specific problem statements, and a description of data required to support decisions to take action
 - The decision rule is dependent on (1) expected conditions; (2) hierarchy or ranking of likely response actions; and (3) clarity of problem statement, including specificity of criteria and how they are measured

For each of the following problems, what is the hierarchy of probable technologies?

Problem A: Municipal landfill thought to have drums of liquid waste

- ✓ Hot spot removal with capping
- ✓ Cap
- ✓ Exhumation

Problem B: Hot spot of Pu-239

- ✓ Removal
- ✓ In situ vitrification

Problem C: Gasoline plume in soil

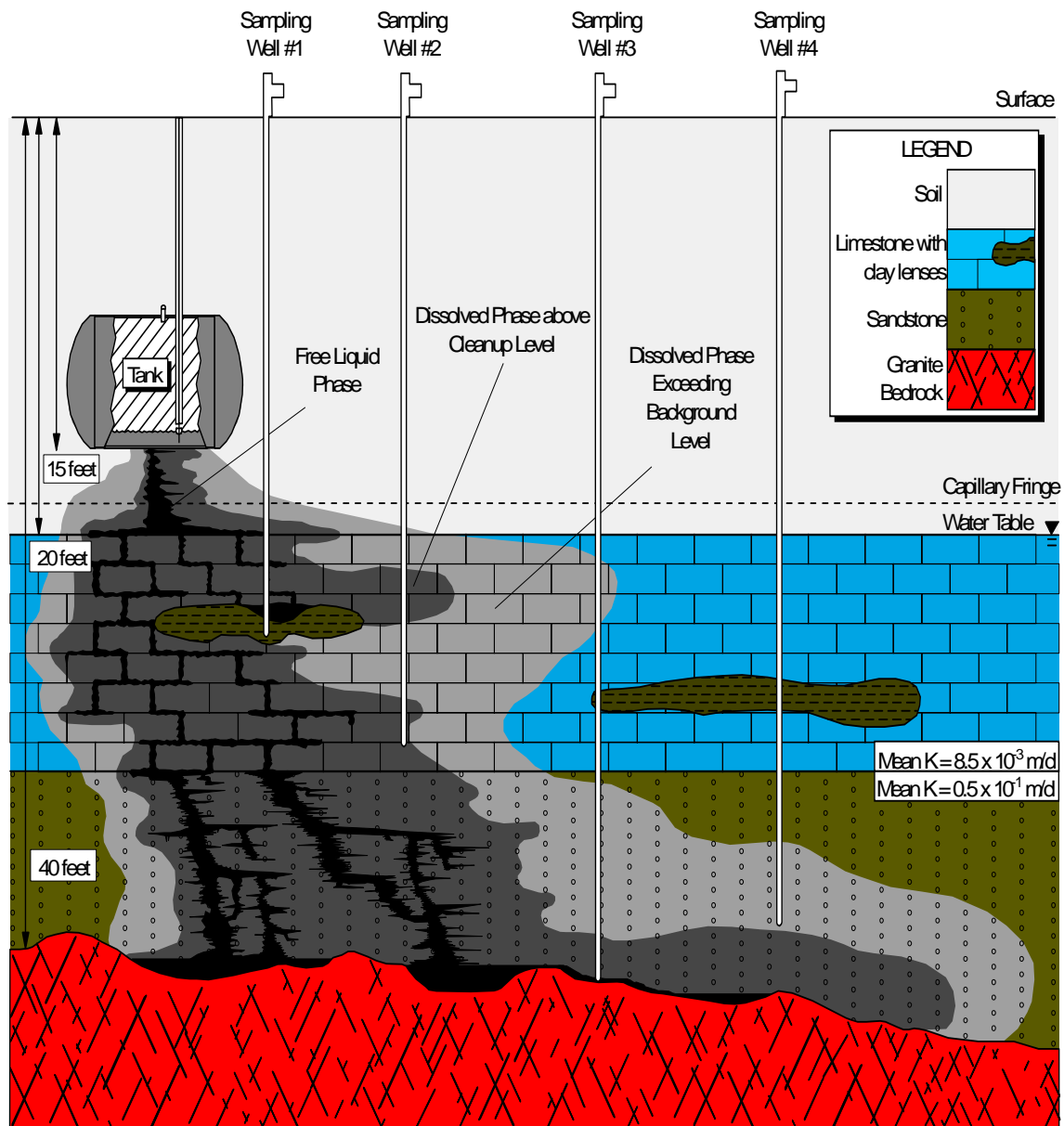
- ✓ Soil vapor extraction
- ✓ Biovent
- ✓ Excavate/thermal desorption

Problem D: Cs/Sr contaminated sediments in stream

- ✓ ?

Problem A. Uncertainty Matrix for Evaluating Probable Technologies

Probable Technology	Conditions Affecting Performance	Probable Range of Conditions	Threshold at Which Technology Becomes Undesirable	Means of Identifying When Threshold is Crossed	Alternative or Contingency
Hot spot removal followed by capping	Ability to locate hot spots safely	Conditions either allow or do not allow location of hot spots by geophysical (non-intrusive) methods	Hot spots can only be located by intrusive sampling that could release the hot spots or accelerate their migration	Determine nature of hot spots and their fingerprint compared to other matrix	Capping without hot spot removal
Capping without hot spot removal	Potential for intrusion that breaches cap under future land use	Institutional controls to unrestricted land use	Unrestricted residential or industrial land use	Reach stakeholder consensus on future land use	In-situ stabilization or exhumation
Exhumation followed by off-site storage and disposal	Volume of excavated media	Volume=0 to maximum volume of WAG	Volume of excavated media exceeds capacity of selected storage or disposal site	Maintain running inventory of excavated volume	Use alternate storage or disposal site with additional capacity
	Ability to meet waste acceptance criteria (WAC) of selected storage or disposal site	Excavated media either do or do not meet WAC of selected storage or disposal site	Excavated media do not meet WAC of selected storage or disposal site	Sample and analyze excavated media as required by WAC	Use alternate disposal or storage site



New Data

- ▶ Tank contains 1.5 feet of sludge and liquid. Liquid appears to be water infiltrating during recharge and high seasonal water table fluctuations
- ▶ Sampling of tank contents shows presence of Tc-99
- ▶ Tc-99 was found in further plume sampling done at sampling well #2 at a concentration of 390 pCi/L; the preliminary cleanup goal for Tc-99 is 300 pCi/L (subject to completion of a full risk evaluation)

Small group exercise:

- A. Using all available data, what is the hierarchy of probable technologies for:

The tank?

The groundwater?

- B. Which problems, if any, in this hypothetical groundwater contamination scenario are amenable to a phased approach?

Summary of tank data:

Results from routine quarterly sampling

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